49 CFR §192.625
Odorization: A Matter of Protection

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"Nothing is ever truly lost until you begin to look for it!"., (Murphy's Law, Corollary #12.) Such is true with odorization of fuel gases. Odorization exists as a normal part of gas operations, providing a smell to the product. Only when attempting to verify adequate odor levels do problems begin to creep in.

Odorization Requirements

Odorization of natural gas is done for two reasons. First, it helps furnish an added level of safety and security to the gas system by providing a warning device for the public. It is undoubtedly the most important aspect of gas operations. We depend on odorization to protect our families and ourselves. Without this critical component, their safety could not be assured.

Secondly, odorization is required by the Pipeline Safety Regulations of the Department of Transportation, in 49 CFR 192, section 192.625. The key point in both these requirements is that the odor must provide a WARNING that prompts the public to TAKE ACTION when detected. This is the difficult area of odorization, determining how much is enough.

Let's first look at the regulations. 192.625. This performance language rule provides the guidance for odorization levels. It states in part:

§192.625 Odorization of gas

(a) A combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.

(e) Equipment for odorization must introduce the odorant without wide variations in the level of odorant.

(f) Each operator shall conduct periodic sampling of combustible gases to assure the proper concentration of odorant in accordance with this section.

This is performance language in its truest sense. There are no hard and fast definitions for "readily detectable" or "normal sense of smell", so we must interpret these as best as we can. Using a dictionary, "readily detectable", can be defined to mean "speedily or easily determine the existence, presence or fact of." A "normal sense of smell" is more difficult, but if many, varied

people are used in a testing program, then the total results may give an indication of the overall sensitivity of the group.

Injection without wide variations in odorant levels is dependent on the type of odorizer, and in some cases cannot be controlled. However, this is often interpreted to mean the injection rate does drop to zero. Periodic sampling is also difficult to pin down, and again using a dictionary, we can interpret this as "on a regular schedule." The overall intent is to provide enough testing to be able to prove the gas is continuously odorized, as specified in paragraph 192.625(a).

Developing an Odorization Program

An odorization program consists of three parts: odorant selection, method of injection and verification of odor intensity. Odorants and injection will be covered briefly, with the main emphasis on verification. This area is often the most difficult, with numerous problems to consider.

Odorants in use today are primarily blends of various organic sulfur compounds; mercaptans, sulfides or thiophane (THT). Blends can be categorized as all mercaptan, mercaptan-sulfide, or mercaptan-THT. Ethyl mercaptan issued as a single component for LP gas, and THT is often used as a single component for natural gas.

Deciding which blend to use encompasses several parameters. No one odorant has been identified as "the best" for all systems. Operators should consider type of odorizers in the system, type of distribution system, gas quality, history of system odorization, soil conditions, and peak shaving operations. Finally, the operator should discuss these factors with theory odorant supplier, to decide on the most appropriate odorants for each system. While this description has been short, in no way should the importance of this process be diminished.

There are many types of odorizers in use throughout the gas industry. Wick, wick-bypass, sweep and drip types are found most on smaller systems. Pump injection systems have made great advances during the last few years, and are found on all systems except individual farm taps. These newer injection systems take an input from a measurement device and can control injection rates very accurately. Again, however, discussion with the manufacturer is critical for correct sizing.

Before we can begin a discussion of verification, it is important to understand what problems may be encountered in odorization. There are two sets of factors that must be considered; those which affect odorant quantity and those which affect odor quality. Let us consider at this point, however, that the odorizer is always working as desired, so that we can look at what problems occur once the odorant is injected into the gas stream.

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Problems in Odorization

Several factors can directly influence the quantity of odorant in the gas stream. The premise that must be accepted here is that when odorant quantity decreases, odor intensity decreases. These factors are:

- Odorizer shut down
- Contaminants in odorizer
- Natural occurring sulfur
- Distillates in pipeline
- Pipewall adsorption
- Oxidation in pipeline

All these problems are, to some extent, controllable by the operator. The first would prevent odorant from being injected at all, the rest affect the quantity of odorant in the gas stream. Natural sulfurs, and even ethyl mercaptan from LP peak shaving operations can chemically react with some odorants, causing a loss of odor. Distillates can absorb odorant, and the pipe itself can have odorant absorbed or adhere to the pipe wall. Oxidation is the reaction between the sulfur compounds and the rust on the steel pipe wall. All reduce the amount of odorant in the gas stream, again reducing the odor intensity. Changing gas flow rates and increasing injection rates are two of the more common solutions to these problems.

Another set of factors, those which affect odor intensity, are more difficult to control. These problems include:

- Physical ailments
- Soil adsorption
- Masking
- Psychological effects

Age and health have a direst bearing on a person's ability to smell gas. In using a variety of personnel to conduct odor tests, i.e., smokers, men, women, old and young, the operator can get better information on the odor perception by the public as a whole. Testing personnel should not be limited to only gas company personnel.

Soil is a great filter for odorants, and by the time an underground leak migrates into a building, the gas may be stripped of odorant. In many cases, the gas odor is modified by the smell of the dirt as well. This masking effect is also present in areas where other odors are present, such as restaurants and hospitals. Finally, the human mind can be made to think a gas odor is present just through the power of suggestion, such as a television news report or newspaper story.

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Verification of Adequate Odorization

Once these problems with odorization are acknowledged and understood, a comprehensive verification program can be developed. This program will include most, if not all of the following:

- Injection rate calculation
- Odorizer inspection
- Customer complaint records and frequency
- Tests conducted by service personnel on routine calls
- Odor concentration meter tests
- Room odor tests (difficult, not widely used)
- Chromatographic analysis

Injection rate determination will help the operator comply with paragraph (e) of the regulation. An odorizer inspection goes hand in hand with this calculation as the odorant volumes are collected in the field at the odorizer site. These two actions will verify that at least something was injected and the equipment is in good working order.

Customer complaint records and frequency of complaint calls is a vital part of the odor verification process. This is the evidence from the public itself that a gas odor has been detected and responded to. While not a quantitative measure of odor intensity, these calls help to verify the quality of the odorization program. A rule of thumb developed in industry is generally 1-2 calls received per week per 1000 meters. It is important that all gas sources, such as pilot lights out and preignition odors, as well as bona-fide leaks be counted in this total. As a system develops this statistic, then deviations from the norm act as indicators of changes in the odor levels and potential odorization problems.

Service personnel should make :sniff tests" of pilots and gas sources on routine calls. A record of the odor intensity, strong, medium or weak, is then recorded on each service order where applicable. Again, this is not a quantitative test, but awareness of the gas odor intensity can provide preliminary information of developing problems.

Two odor concentration meters are currently available for testing odor intensity at the specified gas-in -air levels. The Odorometer is manufactured by Bacharach, Pittsburg, Pennsylvania and the Odorator is made by Heath Consultants of Houston, Texas. Both devices dilute gas through a blower system, and the operator smells the effluent at an exhaust post. When a readily detectable odor is determined, a percent gas-in-air reading is taken. Use of this instrumentation is the only available means of determining compliance with 192.625 (a).

Testing with this equipment is normally done by gas company personnel, often specifically assigned to this task. Operators should be encouraged to include as many persons as possible as test subjects, such as office personnel and others who are not working with gas on a daily basis.

Service personnel should also carry an instrument and during service calls ask the customer to test the gas odor. This method will help in verifying that persons of all ages, occupations, sex, and background can detect the gas odor.

How often should tests be conducted? One general rule that has been developed is one test per week per 1000 meters, up to two or three tests per day, but no less than two tests per week. This provides continuing information as well as a constant awareness of the odor intensity. As with all testing programs, all tests should be recorded, and those indicating unsatisfactory readings need to be followed up and documented.

Room odor test are still conducted in some areas. However it is a cumbersome test, and requires detailed planning and resources. It is not longer widely used, having been replaced with instrument tests.

Chromatographic analysis provides detailed information on the odorants carried in the gas stream. It is an excellent method to verify injection of odorant and to show consistency in rates. Portable systems can be used to monitor remote locations to track odorant mixing and dispersion. A new application is to use odorants as a tracking device, injected in a specific gas source and traced throughout the system. It should be noted though, that his is an analysis of the gas stream, and does not indicate the odor intensity.

An annual review of the company procedures for odorization will keep all personnel aware of this vital operation. Positive activities can be identified and continued, and problems areas corrected. This audit will allow personnel to explore the implementation of new technology that would enhance the odorization program. Above all, increased diligence to odorization will benefit this important aspect of public safety.

This discussion has focused on the problems that can occur with odorization and the methods to verify odor intensity. Close attention must be paid to this vital part of gas operations. Continuous odorization is required by the regulations, and constant vigilance is required to insure continuing public safety.